The role of London airports in providing connectivity for the UK: regional dependence on foreign hubs

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THE ROLE OF LONDON AIRPORTS IN PROVIDING CONNECTIVITY FOR THE UK: REGIONAL DEPENDENCE ON FOREIGN HUBS

1. BACKGROUND

The urban hierarchy in the UK has changed substantially over the past decades and the most important centres, especially London and the South East, have enhanced their economic performance with respect to the rest of the country (DCLG, 2011; Taylor et al., 2009; Parkinson et al., 2006; and Hall et al., 2001). This situation can be illustrated by the development of air transport services in the UK. The UK airport system is the busiest in Europe[1], and the distribution of passenger traffic is anything but balanced (Table 1). In 2013, approximately 62% of all traffic served by the UK system (138 million passengers) travelled through one of the five main airports in South East England: Heathrow, Gatwick, Stansted, Luton, and London City (CAA, 2014). These five airports combined offered flights to 399 international destinations in 106 countries all over the world (Source: Official Airline Guide). In contrast, all remaining airports outside the South East region combined (they will be referred throughout this paper as "regional airports") provide direct flights to only half the number of destinations (200 international destinations in 52 countries). These figures support the view that London airports, from their central position in the UK urban hierarchy, may play a key role in providing worldwide connectivity for the other UK regions.

Table 1. Passenger traffic of UK airports, 2013.

Airport	*Passengers*	*share (%)*	*Airport*	*Passengers*	*share (%)*
Heathrow	72,367,054	31.7%	Manchester	20,751,581	9.1%
Gatwick	35,444,206	15.5%	Birmingham	9,120,201	4.0%
Stansted	17,852,393	7.8%	Bristol	6,131,896	2.7%
Luton	9,697,944	4.2%	Newcastle	4,420,839	1.9%
London City	3,379,753	1.5%	East Midlands	4,334,117	1.9%
Southampton	1,722,758	0.8%	Liverpool	4,187,493	1.8%
Southend	969,912	0.4%	Leeds Bradford	3,318,358	1.5%
Other	8,575	0.0%	Exeter	741,465	0.3%
Total South East England	**141,442,595**	**61.9%**	Doncaster Sheffield	690,351	0.3%
Edinburgh	9,775,443	4.3%	Bournemouth	660,272	0.3%
Glasgow	7,363,764	3.2%	Norwich	463,401	0.2%
Aberdeen	3,440,765	1.5%	Other	1,034,358	0.5%
Prestwick	1,145,836	0.5%	**Total England (Ex-South East)**	**55,854,332**	**24.4%**
Inverness	608,184	0.3%	Belfast International	4,023,336	1.8%
Highlands/Islands/Other	941,637	0.4%	Belfast City	2,541,759	1.1%
Total Scotland	**23,275,629**	**10.2%**	Derry	384,973	0.2%
Cardiff	1,072,062	0.5%	**Total Northern Ireland**	**6,950,068**	**3.0%**
Total Wales	**1,072,062**	**0.5%**	**Total UK**	**228,594,686**	**100.0%**

Source: UK Civil Aviation Authority.

The existing literature has already established the influence of air traffic services on economic development and the attractiveness of a region (e.g., Goetz, 1992; Brueckner, 2003; Green, 2007; Bel and Fageda, 2008; Bilotkach, 2013). Furthermore, air transport connectivity is a crucial factor influencing the position of regional population centres in the world-city hierarchy (Zook and Brunn, 2006; Derudder and Witlox, 2008), and their integration in the globalization dynamics (Goetz and Graham, 2004; Cidell, 2006; Otiso et

[1] In 2013, the UK system served approx. 25% of all air travellers in Europe (EU-28) (Eurostat, 2014).

al., 2011). Whilst UK regions have become well connected to many European destinations with the growth of low-cost airlines, their weak position in the UK urban hierarchy limits their ability to capture direct air services to intercontinental destinations, along with the added value they bring (Shin and Timberlake, 2000; Hall, 2009; Bentlage, et al., 2013). Currently, these markets are accessible indirectly via a hub airport, for which the natural choice seems to be Heathrow (ITC, 2013). This view is explicitly stated in the UK Aviation Policy Framework document, which points out that "continued connectivity to London is essential to regional economies and national cohesion" (UK Government, 2013).

Indirect connectivity through hubs is a way to significantly increase the overall connectivity of regional airports (Suau-Sanchez and Burghouwt, 2012). However, it also could be argued that this places those regions in a vulnerable position as their connectivity is dependent on the decisions taken at the hub airport. This is evidenced by the evolution of traffic at the five main London airports during the last decade, which shows a steady decrease in the number of annual flights available to other UK regions, from 74,875 in 2004 to 51,647 in 2013 (a 31% drop). A similar trend is observed in the number of regional UK destinations that are connected by air to the capital. Figure 1 shows that, since 2009, the five main London airports combined are connected by air to less cities in the rest of the UK than Amsterdam and, as of 2013, they reach the same number of cities as Paris-Charles de Gaulle (CDG). Both European hubs combined offer 35,308 annual frequencies to UK regions, which represents 68% of what is offered by the London airports

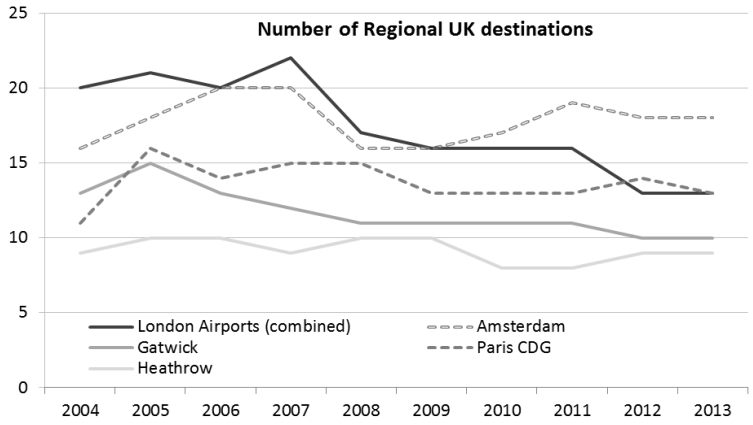

Figure 1. Evolution of regional UK destinations served from selected airports 2004-2013
Source: OAG, own elaboration

The shortage of runway capacity in the South East can be cited as the cause of the problem. Although the system has capacity to accommodate some additional passenger growth in the short-term (e.g. at Stansted, Luton, or Southend), Heathrow, which is by far the busiest airport in the UK and home of the flag carrier British Airways, is already operating at full capacity and presents important expansion difficulties due to the urban developments around the airport.[2] Given its level of saturation, in order to continue growing, airlines have given up feeding services from the rest of the UK and, by relying on the strong London market, have substituted them with long-haul services that are offered using larger aircraft that accommodate more passengers (Table 2). In addition, the lack of room for new route developments at Heathrow has led to an evident stagnation in the number of destinations served during the last decade, especially in comparison with other European and Middle Eastern hubs. These figures challenge the traditional status of Heathrow, not only as one of the world's main international gateways, but also as the main hub "for the UK".

[2] The smaller London-City Airport is also operating close to full capacity.

This situation, in combination with the strong competition for passenger traffic that exists between UK, European, American, Middle Eastern, and Asian major carriers – which seek to transport passengers via their hubs (ITC, 2014) –, is changing the way air transport demand from UK regions is being served. Recently, the Airports Commission set up by the UK Government to provide advice on airport expansion options[3] alerted to the risk of "decoupling" UK regional airports from London in an effort to improve their indirect connectivity and competitiveness[4]. This is evidenced by an increasing number of regional passengers in international routes connecting through hubs other than Heathrow, such as Amsterdam, Paris, or Dubai (Airports Commission, 2013). The two main consequences of this possible "demand leakage" were pointed out by the Independent Transport Commission (ITC)[5]. First, the reduction in the number of flights between the UK regions and London would constrain domestic connectivity. Secondly, the UK would become dependent on foreign aviation policies to guarantee future regional connectivity to worldwide markets (ITC, 2013). While the problem has indeed been identified, no detailed measurements of the scale of this "decoupling" have been produced, mainly because of the lack of appropriate data on passenger itineraries and actual hub choices on intercontinental routes.

Table 2. Evolution of traffic indicators at London Heathrow and selected airports 2004-2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Change 04-13%
Number of annual flights to UK regions	31,218	31,880	30,011	30,224	31,135	26,632	25,743	23,097	22,739	23,375	-25.1%
Average seats per aircraft movement	198	200	197	202	195	195	203	202	207	210	6.1%
Number of destinations served-Heathrow	189	185	194	186	176	172	167	173	176	176	-6.9%
Number of destinations served-Amsterdam	240	250	250	259	246	251	266	278	275	275	14.6%
Number of destinations served-Paris CDG	239	259	260	264	277	285	280	279	273	274	14.6%
Number of destinations served-Frankfurt	291	293	286	297	289	285	294	295	309	293	0.7%
Number of destinations served-Istanbul	114	124	149	155	158	171	173	188	216	234	105.3%
Number of destinations served-Dubai	139	136	147	154	163	169	180	190	200	220	58.3%

Source: OAG, own elaboration

Within this context of debate on the future UK aviation policy, this paper aims to measure the role of airports in South East England, particularly Heathrow, in providing connectivity to the UK, with especial focus on the international markets that originate from regional UK airports. Where previous Government-related publications on this topic rely on limited CAA Statistics, we employ an MIDT dataset that allows for more detailed characterisation of airport connectivity in different origin and destination markets. The available data covers all worldwide passenger itineraries served by the European airport network during May 2013. With that information, we first establish whether the congested Heathrow Airport can currently be considered the most important hub in both Europe and the UK, using indicators of traffic generation, connectivity, and centrality that are already established in the literature. Its performance in all dimensions is benchmarked against other major airports in Europe. Secondly, we focus on the role played by airports in the South East in facilitating connections between regional UK airports and the rest of the world. Individual results for each of the four Home Nations (England, Scotland, Wales, and Northern Ireland) are also provided. The goal is to identify on which airports UK regions depend upon for worldwide connectivity. These results are explained within the context of the current trends in the air transport market of footloose connecting passengers, hub-bypassing and seat deconcentration. Finally, the

[3] The Airports Commission was set up in September 2013 by the UK Government to provide independent advice on "identifying and recommending options for maintaining the UK's status as an international hub for aviation and immediate actions to improve the use of existing runway capacity" (Airports Commission, 2013).

[4] Suau-Sanchez and Burghouwt (2012) also report the increasing role of foreign hubs in shaping the accessibility between Spain and the rest of the world.

[5] The ITC is a research charity land use and transport think tank. It was launched in 1999 in response to the Government's Transport White Paper.

advantages and disadvantages of the current situation are discussed and some policy options to improve connectivity of regional airports are identified.

The rest of this paper is structured as follows: Section 2 describes the MIDT database and the methods used to measure airport connectivity. Section 3 presents the results and discusses the main policy implications. Finally, Section 4 summarizes our main conclusions.

2. DATA AND METHODOLOGY

2.1 MIDT dataset

We obtained a Marketing Information Data Transfer (MIDT) dataset from the OAG Traffic Analyser, containing a large sample of airline bookings for May 2013. This particular month was chosen as the overall level of traffic is close to the average monthly traffic for 2013. Each record contains information on the published airline, as well as the points of origin and destination, the connecting airports (up to two intermediate stops), and the number of passengers. The airports of origin and destination determine the market to which the passengers belong. Most markets can be served via different itineraries, depending on the points of connection. Thus, an airport can contribute to a market in three different ways, as origin, destination, or intermediate point. In our dataset, all worldwide markets that are served by at least one European airport are represented. This includes all itineraries that originate and/or terminate in Europe, as well as those markets between other geographic regions that connect via at least one European hub. In this paper, European airports are defined as those located in the European continent (including the European parts of Turkey and Russia) and its associated regions (i.e. Canary Islands, Madeira, and Azores). European airports can be split between European Economic Area (EEA) and non-EEA members. Switzerland is included in the EEA group.

Table 3. Distribution of passenger demand by geographical markets (May 2013)

(Passengers travelling between)	*EEA*	*Rest of Europe (non-EEA)*	*Africa*	*Asia-Pacific*	*Latin America and Caribbean*	*Middle East*	*North America*
EEA	39,467,960	4,754,625	2,805,692	3,533,354	1,468,124	2,077,940	4,245,743
Rest of Europe (non-EEA)		4,986,112	194,130	1,526,990	92,764	861,170	330,923
Africa			7,121	24,707	7,987	29,458	115,009
Asia-Pacific				14,866	41,904	22,512	167,143
Latin America and Caribbean					0	27,111	0
Middle East						2,397	153,938
North America							0

Source: MIDT, own elaboration. Note:EEA: European Economic Area.

The dataset contains 489,573 different itineraries in 148,305 directed markets, involving 66.9 million passengers, 436 airlines, and 2,158 airports (458 from the EEA). Table 3 shows the distribution of this passenger demand by geographical markets. The largest market served by the European airport network is intra-EEA, which accounts for 51.4% of its total passenger traffic. When non-EEA countries are also considered, the total share of intra-European traffic rises to 73.5%. Of the remaining network traffic, 25.6% is devoted to linking Europe with the rest of the world, with the most important destinations being Asia-Pacific and North America. The remaining 2.2% of passengers make use of European airports as gateways during their journeys between other continents. Note that Europe has a small presence in each continent pair, except the intra-American ones.

The original sources of information for the MIDT dataset are Global Distributions Systems (GDSs) such as Galileo, Sabre, or Amadeus, among others. According to ARG (2013), 44% of all bookings of major airlines were done through GDSs in 2012. The proportion increases to 55% for network airlines, while low-cost carriers (LCCs), that prefer direct sales, only get 16% of their bookings via GDSs. This imbalance is an important limitation of the original

dataset, as low-cost carriers may be underrepresented. In order to correct that, the provider of our data (OAG Traffic Analyser) adjusted the market figures using mathematical algorithms based on frequencies and supplied seats in each flight sector. The reliability of these adjustments, in terms of LCC representation, can be judged by calculating the airline traffic shares in the intra-EEA market that result from our data. These are shown in Figure 2. The combined market shares of LCCs is approximately 46%, which is virtually the same estimate provided by the European Commission for the EU Common Market in 2013 (EC, 2014).

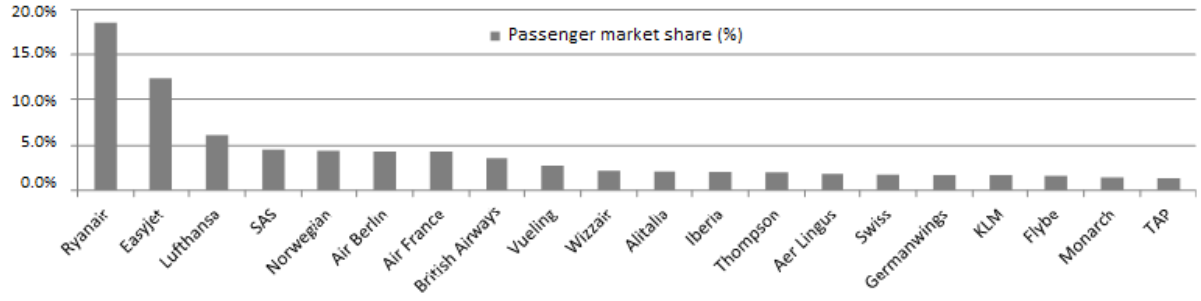

Figure 2. Top 20 airline traffic shares in intra-EEA markets (May 2013)
Source: MIDT, own elaboration.

It is also important to acknowledge another limitation of the MIDT dataset that directly relates to the assessment of connectivity of UK regions. While our data may indicate that there is limited traffic from UK regional airports to long-haul destinations, this does not necessarily mean that the actual demand from UK regions to long-haul markets is relatively small. As Lieshout (2012) states, catchment areas are not static, but depend on different factors, among them the type of destination. Thus, an airport, such as Heathrow, offering a relatively high level of service to a certain long-haul destination is likely to attract originating passengers from hinterland regions[6] (CAA, 2011). This effect will be potentiated by the lack of long-haul services out of the regional airports. Unfortunately, the CAA passenger surveys only record the place of residence of people terminating their journey in the South East. Thus, since there is no information on the place of residence of travellers (Dobruszkes et al., 2011), we cannot find out the proportion of passengers at Heathrow that are in fact starting their trip in another UK region and transferring to London by road or rail. In the absence of detailed information on the mentioned transfers, our results do not intend to be an accurate representation of the air transport demand of UK regional passengers, rather than an assessment of the connectivity options that are available in each region's airports.

2.2 Airport hubbing and connectivity

Using this data, the first objective is to characterize the relative importance of London Heathrow and other major airports as "hubs" within a number of markets served by the European airport network. With regards to the definition of "hubbing", several authors note that this concept is linked to the ability of an airport to support hub-and-spoke airline operations, which are typically achieved by consolidating originating and transfer passenger flows (Button, 2002; Doganis, 2010). Following this definition, Rodríguez-Déniz et al. (2013) proposed two simple demand-based indicators to measure the dimensions of airport "hubbing": traffic generation and connectivity. We adapt these indices to our case study.

The first indicator (Equation 1: OD_i) quantifies each airport's importance as traffic generator. It is calculated as the ratio between the passengers in a relevant set of markets who originate or terminate at the *i-th* airport (od_i), and the total number of unique passengers in the same

[6] In the case of Amsterdam, market shares of Schiphol Airport in the hinterland regions are larger for intercontinental destinations than for European destinations (Lieshout, 2012).

markets (*P*). For example, if there are 14.8 million passengers travelling between the UK and the rest of the world, and 3.97 million of those passengers either originate from or terminate at London Heathrow, the airports' *OD* index in UK↔international markets will be 26.7%.

The second indicator (Equation 2: C_i) measures the airport's contribution to other *od* markets as a connecting gateway. It is calculated as the ratio between connecting passengers at the *i-th* airport (c_i) and total passengers that do not originate or terminate at the *i-th* airport ($P - od_i$). For example, if there are 10.8 million passengers travelling between the UK and the rest of the world who did neither originate nor terminate at London Heathrow, yet 150 thousand of those passengers do connect through it, the airport's *C* index in UK↔international markets will be 1.4%. This value indicates how relevant each airport is as a hub in order to facilitate connections between other city-pairs[7].

$$OD_i = \frac{od_i}{P} \qquad (1)$$

$$C_i = \frac{c_i}{P - od_i} \qquad (2)$$

$$C_i' = \frac{c_i}{P^c} \qquad (3)$$

$$CR = \frac{P^c}{P} \qquad (4)$$

When the market definition is too narrow to allow for major airports to act as both traffic generators and connecting gateways (e.g., Heathrow cannot originate passengers in Regional UK ↔ international markets), the focus is placed on connectivity. In that case, a third indicator is used (Equation 3: C'_i), which simply measures the proportion of connecting passengers served by the *i-th* airport with respect to the total number of unique passengers travelling in connecting routes within the relevant markets (P^c). Both used individually or in combination with the "hubbing" indexes, this indicator allows us to rank airports in terms of absolute connectivity and can also be aggregated in order to create airport categories. This feature will be useful at the time of measuring the dependence of regional UK markets on non-UK hubs. Finally, in order to put the connectivity analysis in proper context, the overall connecting rate (Equation 4: *CR*) in each market is also reported, defined as the proportion of connecting passengers over total passengers. A high dependence on non-UK hubs can be mitigated or reinforced by connecting rates that are significantly low or high, respectively.

3. RESULTS AND DISCUSSION

3.1 The different roles of Heathrow airport

Establishing whether London Heathrow is currently (as of 2013) the most important hub for the UK requires first of a definition of what makes an airport a "hub". As established in the previous section, we will focus on measuring the two dimensions of traffic that an airport is expected to possess in order to allow for successful hub-and-spoke operations: traffic generation (*OD*) and connectivity (measured by *C* and *C'*). A second consideration is the fact that London Heathrow does not exclusively serve the UK but also plays an important role in the worldwide and European air transport networks. A comparison of these different roles provides context to discuss Heathrow's contribution to UK connectivity.

[7] This index is based on the concept of flow centrality from Freeman et al. (1991). In its original application to social networks, flow centrality was computed as the total flow of information that passes through node *i* divided by the total flow between all pairs of nodes where *i* is neither a source of information nor its final destination. The extension of this concept to air transport is straightforward (Rodríguez-Déniz et al., 2013).

Table 4 reports the top 20 airports ranked by proportion of connecting passengers (*C'*) in: 1) worldwide routes served by European airports, 2) intra-EEA routes, 3) routes between the UK and the rest of the world.

In the worldwide case, Heathrow stands out in both dimensions, being the first in traffic generation (6.3%), but ranking third in connectivity (behind Frankfurt and Istanbul). From our results it becomes clear that the largest contribution to connecting traffic in the worldwide markets served by European airports comes from the European big-five hubs (i.e., Frankfurt, Heathrow, Amsterdam, Paris-CDG and Madrid), as well as Istanbul and Dubai. As the secondary hub of Lufthansa, Munich also stands out, showing the importance of dual hubs in Europe (Burghouwt, 2014). Despite the unavailability of time-series demand data for further evidence, the unexpectedly high number of destinations served from Istanbul (Table 4) suggests that, despite the trade-off between short- and long-haul flights, the lack of new route developments at Heathrow, together with increased hub competition and aggressive marketing by non-UK airlines such as Turkish Airlines, may damage its ranking among world-class European gateways in coming years.

The picture is different in intra-EEA markets. Heathrow becomes the fourth largest "traffic generator", behind Gatwick, Barcelona, and Palma de Mallorca, which range between 5% and 5.5% OD_i. The connecting rate in this market is limited (less than 9%), since it is terrain for low-cost point-to-point travel. Only some airports that are geographically central to West-East flows (i.e., Frankfurt, Munich, Rome-Fiumicino), North-South flows (i.e., Amsterdam), and gateways to remote regions (i.e., Oslo and Copenhagen) play a role in the intra-EEA market from a connectivity perspective. This result indicates that it is Gatwick, and not Heathrow, the most dominant UK airport with regards to the EEA market.

Table 4. Top 20 airports according to connectivity in different markets (May 2013)

Worldwide Markets served by the European airport network				***Markets within the EEA (incl. Switzerland)***				***UK-International Markets***			
Airport	***Ci'***	***Ci***	***ODi***	***Airport***	***Ci'***	***Ci***	***ODi***	***Airport***	***Ci'***	***Ci***	***ODi***
Frankfurt	8.7%	1.9%	3.3%	Frankfurt	10.5%	1.0%	2.9%	Dubai	10.0%	1.3%	1.0%
Istanbul Ataturk	6.9%	1.5%	3.4%	Munich	9.1%	0.8%	3.3%	Amsterdam	9.9%	1.3%	2.7%
Heathrow	6.0%	1.3%	6.3%	Amsterdam	5.7%	0.5%	3.9%	Heathrow	8.1%	1.4%	26.7%
Amsterdam	5.3%	1.1%	3.4%	Oslo	5.6%	0.5%	3.5%	Frankfurt	5.0%	0.7%	1.0%
Paris CDG	5.2%	1.1%	4.7%	Copenhagen	5.2%	0.5%	3.2%	Paris CDG	4.1%	0.5%	1.2%
Munich	4.4%	0.9%	2.7%	Rome Fiumicino	5.0%	0.5%	3.7%	Istanbul Ataturk	3.0%	0.4%	0.5%
Dubai	4.2%	0.9%	0.9%	Madrid	4.8%	0.4%	4.4%	Doha	2.4%	0.3%	0.2%
Madrid	3.2%	0.7%	3.4%	Paris CDG	3.8%	0.3%	4.0%	Singapore Changi	2.2%	0.3%	0.4%
Rome Fiumicino	2.8%	0.6%	3.1%	Zurich	3.5%	0.3%	2.3%	Abu Dhabi	2.2%	0.3%	0.2%
Sheremetyevo	2.7%	0.6%	2.0%	Stockholm	3.4%	0.3%	3.2%	Chicago O'Hare	2.1%	0.3%	0.3%
Zurich	2.2%	0.5%	2.0%	Vienna	3.3%	0.3%	2.0%	Munich	2.1%	0.3%	1.0%
Vienna	2.1%	0.4%	1.7%	Heathrow	2.9%	0.3%	4.7%	Newark	1.9%	0.2%	0.6%
Doha	1.8%	0.4%	0.2%	Barcelona	2.6%	0.2%	5.5%	Dublin	1.7%	0.2%	3.5%
Copenhagen	1.8%	0.4%	2.3%	Duesseldorf	2.0%	0.2%	2.7%	Atlanta	1.6%	0.2%	0.2%
Oslo	1.5%	0.3%	2.2%	Berlin Tegel	2.0%	0.2%	2.7%	Madrid	1.5%	0.2%	1.0%
Istanbul Sabiha	1.3%	0.3%	1.4%	Brussels	1.9%	0.2%	2.2%	Hong-Kong	1.5%	0.2%	0.5%
Atlanta	1.2%	0.2%	0.2%	Paris Orly	1.7%	0.2%	3.7%	Kuala Lumpur	1.4%	0.2%	0.2%
Abu Dhabi	1.1%	0.2%	0.1%	Palma de Mallorca	1.4%	0.1%	5.0%	Copenhagen	1.4%	0.2%	1.1%
Lisbon	1.1%	0.2%	1.4%	Gatwick	1.1%	0.1%	5.5%	Zurich	1.3%	0.2%	0.9%
Stockholm	1.1%	0.2%	2.2%	Lisbon	1.7%	0.2%	1.9%	Washington Dulles	1.2%	0.2%	0.3%
Total Passengers: 66,959,805				Total Passengers: 38,028,897				Total Passengers: 14,865,572			
Connecting rate: 13,813,059 (20.6%)				Connecting rate: 3,367,110 (8.9%)				Connecting rate: 1,913,941 (12.9%)			

Source: MIDT, own elaboration. EEA: European Economic Area.

In the UK case, Heathrow scores high in both dimensions. The massive level of traffic generation (26.7%) can be linked to the prominence of London as global business centre and tourist destination. In addition, the dominance of the South East in the UK urban hierarchy translates into a large catchment area for Heathrow, which has the capacity to attract a large number of long-haul passengers from other UK regions (CAA, 2011). In terms of absolute connectivity (*Ci'*), Heathrow ranks third. Overall, more UK passengers choose Dubai (10%)

and Amsterdam (9.9%) as intermediate stops rather than Heathrow (8.1%). However, these figures should be interpreted with caution because of Heathrow's massive traffic generation in these markets. Obviously, the 26.7% of UK passengers that originate or terminate at Heathrow will not choose the London hub to connect and will instead feed other hubs. The C_i indicator removes this distortion (*Ci* reports relative connectivity after removing the effect of each airport's *od* passengers) and points at Heathrow as the most relevant airport to other city-pair markets (1.4%), slightly over Amsterdam and Dubai (1.3%). Thus, we can conclude then that despite the large number of UK passengers travelling via foreign airports, Heathrow remains the most important hub for the UK due to its high contribution in terms of traffic generation (*ODi*) and connectivity to other city-pairs (*Ci*) between the UK and the rest of the world. This status, however, is cemented on the enormous level of traffic that travels to and from London. The next section removes the London markets to investigate the role of Heathrow and the South East in providing connectivity exclusively for the markets originating or terminating from UK regional airports.

3.2 The gateways of UK regional airports

Tables 5 and 6 present the top 10 hub choices in routes between UK regional airports and the rest of the world. The first element to highlight is that overall only 14.4% of these regional passengers are traveling via an intermediate hub. The main reason is that most of the international travel (81.2%) from UK regional airports is to/from EEA countries, which is dominated by point-to-point flights. On the contrary, long-haul markets present much higher connecting rates, especially for Asia-Pacific (82.3%), North America (53.7%) and Africa (52.5%). The results also show that non-UK hubs are, in overall, accumulating between 63% and 85% of the transfer passengers to a range of long-haul markets. Nonetheless, from the ranking perspective, Heathrow and Amsterdam are the main gateways of UK regional airports to access the rest of the world, both connecting approximately the same proportion of transfer passengers (*Ci'*=19.1%). The third most important gateway is Dubai (*Ci'*=10.7%), followed by Frankfurt (*Ci'*=6.1%) and Paris-CDG (*Ci'*=6%). Gatwick makes a small contribution that increases the share South East of England airports to 21.7%.

Table 5. Top 10 hub choices in routes to/from regional UK airports by geographical market (I) (May 2013)

Regional UK to/from World		***Regional UK to/from EEA***		***Regional UK to/from Rest of Europe (non-EEA)***		***Regional UK to/from Africa***		***Regional UK to/from Middle East***	
Hub airport	***Ci'***	***Hub airport***	***Ci'***	***Hub airport***	***Ci'***	***Hub airport***	***Ci'***	***Hub airport***	***Ci'***
Amsterdam	19.1%	Amsterdam	23.6%	Istanbul Ataturk	29.2%	Amsterdam	21.5%	Heathrow	21.4%
Heathrow	19.1%	Heathrow	14.6%	Heathrow	19.9%	Dubai	17.1%	Amsterdam	18.3%
Dubai	10.7%	Frankfurt	9.2%	Amsterdam	16.1%	Paris CDG	16.6%	Istanbul Ataturk	16.2%
Frankfurt	6.1%	Paris CDG	6.0%	Frankfurt	11.6%	Heathrow	16.5%	Dubai	15.5%
Paris CDG	6.0%	Dublin	4.7%	Munich	5.2%	Frankfurt	5.6%	Frankfurt	6.4%
Newark	2.9%	Copenhagen	4.2%	Paris CDG	4.4%	Brussels	3.8%	Abu Dhabi	4.8%
Istanbul Ataturk	2.7%	Gatwick	4.1%	Gatwick	1.4%	Istanbul Ataturk	3.4%	Doha	3.8%
Gatwick	2.6%	Munich	4.0%	Zurich	1.2%	Lusaka	2.0%	Paris CDG	3.4%
Dublin	2.5%	Brussels	3.4%	Brussels	1.0%	Gatwick	1.4%	Gatwick	1.7%
Munich	2.2%	Dusseldorf	2.0%	Istanbul Sabiha	1.0%	Abu Dhabi	1.1%	Manchester	1.5%
Total Passengers	5,615,182		4,559,413		262,143		99,675		164,943
Share of total	100%		81.2%		4.7%		1.8%		2.9%
Connecting pax.	809,713		336,222		28,802		52,324		55,391
Connecting rate	14.4%		7.4%		11.0%		52.5%		33.6%
SEE Hubs	21.7%		19.3%		21.6%		17.9%		23.1%
Alt.EEA hubs	43.9%		67.6%		72.7%		52.2%		31.6%
Non-UK Hubs	76.6%		76.8%		77.8%		81.9%		74.5%

Source: MIDT, own elaboration. SEE: South East England. EEA: European Economic Area.

Heathrow acts as the main gateway of UK regional airports for two international markets, the Middle East (*Ci'*=21.4%) and North America (*Ci'*=35.2%), the latter being the most important connecting market in terms of long-haul passengers from UK regional airports. In

these two markets, British Airways, together with the other Oneworld members, offer a wide range of destinations from Heathrow. For example, during the month considered for our analysis (May 2013), Oneworld members offered the highest number of onward destinations to North America from Heathrow (28 destinations). For the Middle East market, Istanbul, Dubai and Frankfurt offered more destinations than Heathrow (10 destinations by Oneworld members), but British Airways and KLM serve a wider range of UK regional airports, hence they can capture more demand and obtain a higher *Ci'* value for Heathrow and Amsterdam.

In this vein, the significant number of UK regional airports served by KLM (13 airports in May 2013) places Amsterdam as an important gateway for UK passengers in all international markets. However, it is significant that it only ranks above Heathrow in the smallest markets –i.e., Latin America and Caribbean (0.8% of the total demand) and Africa (1.8% of the total demand)– and the lower yield markets –i.e., the short-haul EEA market.

For reaching the growingly important Asia-Pacific market, Dubai is by far the airport delivering a higher *Ci'* value: almost 40% of the connecting passengers traveling to Asia-Pacific fly via Dubai. In May 2013, Emirates only served four –but major– UK regional airports (i.e., Birmingham, Manchester, Glasgow and Newcastle), but the exceptional geographical position of Dubai and the large number of destinations offered by Emirates to this market (36 destinations compared to the only 16 destinations offered by Oneworld at Heathrow) make Dubai the main gateway of UK regions to Asia-Pacific. Indeed, as highlighted by Murel and O'Connell (2011) the "Gulf carriers are growing traffic by cannibalising the traditional traffic flows between Asian and European hubs, and by connecting secondary cities as a result of exercising their sixth freedom traffic rights". Tables 5 and 6 also show a relatively new player, Istanbul, that because of its geographical position ranks fairly high as gateway to the Middle East and it is the first hub choice to access non-EEA European destinations. Nevertheless, this latter market is mainly a point-to-point market and connecting passengers only represent 11% of the total.

Table 6. Top 10 hub choices in routes to/from regional UK airports by geographical market (II) (May 2013)

Regional UK to/from Latin America and Caribbean		***Regional UK to/from North America***		***Regional UK to/from Asia-Pacific***		***Regional UK to/from BRIC***	
Hub airport	***Ci'***	***Hub airport***	***Ci'***	***Hub airport***	***Ci'***	***Hub airport***	***Ci'***
Amsterdam	26.5%	Heathrow	35.2%	Dubai	39.5%	Dubai	25.1%
Paris CDG	19.3%	Newark	15.6%	Amsterdam	14.5%	Heathrow	20.2%
Heathrow	16.1%	Amsterdam	13.0%	Heathrow	14.5%	Amsterdam	19.2%
Gatwick	13.1%	Philadelphia	7.4%	Abu Dhabi	7.5%	Paris CDG	9.8%
Frankfurt	5.4%	Atlanta	6.5%	Doha	5.2%	Frankfurt	6.7%
Newark	3.6%	O'Hare	4.1%	Paris CDG	5.2%	Doha	5.8%
Atlanta	3.2%	Dulles	3.3%	Frankfurt	3.0%	Abu Dhabi	3.8%
Lisbon	1.7%	Paris CDG	3.1%	Singapore	2.9%	Istanbul Ataturk	1.6%
Saint Lucia	1.6%	Dublin	2.9%	Istanbul Ataturk	1.5%	Munich	1.5%
New York JFK	0.9%	Gatwick	1.8%	Munich	1.2%	Zurich	1.4%
Total Passengers	47,760		268,251		212,997		72,518
Share of total	0.8%		4.8%		3.8%		1.3%
Connecting pax.	17,749		144,020		175,205		66,168
Connecting rate	37.2%		53.7%		82.3%		91.2%
SEE Hubs	29.3%		37.1%		14.6%		20.5%
Alt.EEA hubs	54.6%		23.1%		25.1%		40.7%
Non-UK Hubs	70.5%		62.6%		85.3%		79.4%

Source: MIDT, own elaboration. SEE: South East England. BRIC: Brazil, Russia, India, China.

We also provide calculations of hub choices to/from BRIC countries. Brazil, Russia, India, and China accumulate more than 40% of the world population and are implicitly given strategic importance by the UK Aviation policy framework when measuring UK connectivity to emerging economies. It is worth noting that trips between BRIC countries and UK regional

airports only account for 1.3% of the total passenger demand.[8] Within this small level of traffic, 91.2% of the passengers connect in an intermediate hub, and 79.4% of those connecting passengers connect using a non-UK hub (25.1% fly via Dubai and 19.2% via Amsterdam), while Heathrow's contribution is slightly over 20%. Table 7 breaks down the UK passenger demand to each of the BRIC countries[9]. As of May 2013, only Russia is served directly from UK regional airports. Although the air service agreement between the UK and India allows carriers to operate between any two airports of these countries (even though considering some frequency limitations for airports other than Heathrow) and the EU-Brazil market enjoys an "open skies" type air service agreement, only Manchester and Birmingham have non-stop services to India during a limited number of summer months that are out of our cross-sectional sample. In the case of China, the current agreement limits the frequency to 31 return services per week between six destinations in both countries.[10] Thus, while UK regions are highly dependent on foreign airports to be connected to BRIC countries, there is still room for further relaxation of the bilateral air service agreements in order to improve the prospects of establishing non-stop connections.

Table 7. UK passenger breakdown to/from BRIC countries, May 2013.

Total UK airports						
Country	**Total Passengers**	**Direct**	**Via South East hubs**	**Via EEA hubs**	**Via rest of World hubs**	**Share to/from country**
Brazil	45,128	21,267	1,371	13,426	9,064	10.30%
China	91,965	45,158	3,272	19,087	24,448	20.90%
India	190,462	85,176	7,004	6,178	92,104	43.40%
Russia	111,511	89,715	1,917	12,015	7,864	25.40%
Total to/from BRIC	439,066	241,316	13,564	50,706	133,480	
Share	100%	55%	3.1%	11.5%	30.4%	100%
Country	**Total Passengers**	**Direct**	**Via South East hubs**	**Via EEA hubs**	**Via rest of World hubs**	**Share to/from country**
Brazil	4,935	0	1,371	3,536	28	6.8%
China	23,665	0	3,272	14,708	5,685	32.6%
India	30,325	0	7,004	3,547	19,774	41.8%
Russia	13,593	6,205	1,917	5,167	304	18.7%
Total to/from BRIC	72,518	6,205	13,564	26,958	25,791	
Share	100%	8.6%	18.7%	37.2%	35.6%	100%

Source: MIDT, own elaboration. SEE: South East England. BRIC: Brazil, Russia, India, China.

3.3 Results for the UK Home Nations

This section provides disaggregated results for each of the UK Home Nations (England, Scotland, Wales and Northern Ireland). Table 8 presents the breakdown of UK regional traffic to and from worldwide destinations.[11]

Table 8. Breakdown of UK regional traffic to/from worldwide destinations (May 2013)

Traffic originating/terminating in	***Passengers ('000)***	***%***
Airports in England (ex-South East)	4,358.7	77.6%
Airports in Scotland	1,032.2	18.4%
Airports in Northern Ireland	138.9	2.5%
Airports in Wales	85.3	1.5%
Total	5,615.1	100.0%

Source: MIDT, own elaboration.

[8] Note that this does not account for UK residents outside South East England that decide to commute to Heathrow or Gatwick for a long-haul trip.

[9] Note that proportions in Table 6 are calculated over total passengers, while in Table 5 they are calculated over connecting passengers.

[10] With regard to China, it is also worth highlighting the impact of the current fees required by the UK to obtain a Visa, which are higher than those payable for the Schengen area.

[11] Remember that this does not include passengers starting their journey in a different region and transferring by road or rail.

The results for the English regions (Table 9) are similar to those reported in the previous section. While direct connectivity is available to all continents, the dependence on foreign hubs is significant in long-haul markets (Asia-Pacific and BRIC countries) that present much higher connecting rates. Amsterdam and Dubai are the top hub choices while Heathrow remains the main gateway to North America.

Table 9. Breakdown of passenger itineraries: England (ex-South East) to/from worldwide destinations (May 2013)

English Regions to/from	*World*	*EEA*	*Rest of Europe*	*Africa*	*Middle East*	*LAC*	*North America*	*Asia-Pacific*	*BRIC*
Total Passengers ('000)	4,358.7	3,547.1	215.8	76.8	133.7	39.5	176.9	168.8	53.6
Direct	88.8%	94.1%	91.9%	57.5%	73.0%	74.0%	54.5%	26.1%	10.7%
Transfer	11.2%	5.9%	8.1%	42.5%	27.0%	26.0%	45.5%	73.9%	89.3%
via South East England hubs	1.5%	0.7%	0.9%	4.8%	3.8%	4.6%	12.5%	6.5%	11.2%
via rest of UK hubs	0.2%	0.3%	0.1%	0.0%	0.5%	0.2%	0.0%	0.0%	0.0%
via alternative EEA hubs	6.0%	4.9%	4.0%	23.1%	8.7%	18.0%	11.1%	19.2%	38.2%
via Rest of World hubs	3.5%	0.0%	3.1%	14.6%	14.1%	3.3%	21.8%	48.2%	39.9%
Total non-UK hubs	9.5%	4.9%	7.1%	37.7%	22.8%	21.2%	32.9%	67.4%	78.1%

Source: MIDT, own elaboration.

The results for Scotland (Table 10) indicate that direct connectivity is available to all regions except Asia-Pacific. The dependence on foreign hubs in this market exceeds 70% of passenger traffic, and a similar picture is drawn for the air markets between Scotland and the BRIC countries. In spite of that, London Heathrow is overall the first hub choice in most geographical markets given the strong air links between London and Edinburgh/Glasgow. These links may ensure a lower dependence on foreign hubs, but at the same time poor direct connectivity to foreign countries from Scottish airports is a contributory factor. Hence, developing new non-stop connections between Scotland and the Asia-Pacific region should be given appropriate consideration in the relevant policy frameworks.

Table 10. Breakdown of passenger itineraries: Scotland to/from worldwide destinations (May 2013)

Scotland to/from	*World*	*EEA*	*Rest of Europe*	*Africa*	*Middle East*	*LAC*	*North America*	*Asia-Pacific*	*BRIC*
Total Passengers (‘000)	1,032.2	823.9	33.9	18.4	27.2	7.5	80.4	41.0	16.9
Direct	75.2%	86.4%	74.2%	19.2%	41.8%	22.8%	32.6%	0.0%	2.8%
Transfer	24.8%	13.6%	25.8%	80.8%	58.2%	77.2%	67.4%	100.0%	97.2%
via South East England hubs	9.3%	4.4%	10.5%	25.1%	23.3%	36.7%	34.9%	28.8%	38.3%
via rest of UK hubs	1.8%	0.6%	0.2%	0.8%	1.7%	0.9%	0.5%	0.4%	0.0%
via alternative EEA hubs	10.0%	8.6%	10.0%	43.6%	19.3%	32.8%	16.5%	27.5%	38.0%
via Rest of World hubs	3.7%	0.0%	5.2%	11.2%	13.9%	6.8%	15.6%	43.3%	20.9%
Total non-UK hubs	13.6%	8.6%	15.2%	54.8%	33.2%	39.6%	32.1%	70.8%	58.9%

The results for Northern Ireland (Table 11) indicate that more than 80% passengers fly non-stop to their destinations, although most of passengers fly to EEA destinations. In all geographical markets except North America, South East England hubs are the most important connecting gateway. The contribution of London airports is crucial in linking Northern Ireland with long-haul destinations in Africa, Asia-Pacific, Latin America & Caribbean, where no direct travel options are available.

The results for Wales (Table 12) indicate that there are no direct connections for several long-haul markets, including the BRIC countries, in which 100% of the observed itineraries are served via foreign hubs. While these markets are indeed very small the results are relevant in policy terms as they show the indirect air connectivity between Wales’ own airports and the emerging economies is not provided via the London airport system. Rather EEA airports provide most of the connections. The alternative for Welsh residents is to transfer by road or rail to other airports. In this regard, Heathrow and Birmingham can be considered airports of reference for the south of Wales in addition to Cardiff. On the other hand, for the north of Wales, Liverpool and Manchester are the main reference airports. Thus, road and rail

transport policy actions could be taken to provide appropriate ground transport services so Wales remains well connected with all the world's regions.

In view of the above, it is clear that the policy debate cannot adopt exclusively a nationwide focus. Policy makers should develop solutions that address the needs of the individual regions as they present different connectivity profiles.

Table 11. Breakdown of passenger itineraries: Northern Ireland to/from worldwide destinations (May 2013)

Northern Ireland to/from	*World*	*EEA*	*Rest of Europe*	*Africa*	*Middle East*	*LAC*	*North America*	*Asia-Pacific*	*BRIC*
Total Passengers ('000)	138.9	119.6	3.7	0.9	1.8	0.6	10.1	2.2	1.0
Direct	81.4%	89.6%	80.9%	0.0%	20.8%	0.0%	25.7%	0.0%	0.0%
Transfer	18.6%	10.4%	19.1%	100.0%	79.2%	100.0%	74.3%	100.0%	100.0%
via South East England hubs	10.2%	5.4%	13.7%	79.2%	66.0%	78.2%	29.6%	81.3%	89.1%
via rest of UK hubs	2.7%	2.7%	1.1%	4.4%	7.5%	3.5%	1.0%	2.9%	2.8%
via alternative EEA hubs	2.4%	2.4%	2.5%	12.4%	1.6%	3.7%	0.4%	2.6%	4.9%
via Rest of World hubs	3.3%	0.0%	1.8%	4.0%	4.0%	14.6%	43.4%	13.2%	3.2%
Total non-UK hubs	5.7%	2.4%	4.2%	16.4%	5.6%	18.3%	43.7%	15.8%	8.1%

Source: MIDT, own elaboration.

Table 12. Breakdown of passenger itineraries: Wales to/from worldwide destinations (May 2013)

Wales to/from	*World*	*EEA*	*Rest of Europe*	*Africa*	*Middle East*	*LAC*	*North America*	*Asia-Pacific*	*BRIC*
Total Passengers ('000)	85.3	68.6	8.8	3.6	2.3	0.2	0.8	1.0	0.5
Direct	86.9%	86.6%	94.2%	83.0%	66.7%	0.0%	0.0%	0.0%	0.0%
Transfer	13.1%	13.4%	5.8%	17.0%	33.3%	100.0%	100.0%	100.0%	100.0%
via South East England hubs	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
via rest of UK hubs	0.6%	0.5%	0.2%	0.7%	2.4%	0.0%	0.4%	0.3%	0.0%
via alternative EEA hubs	12.0%	12.7%	4.9%	15.2%	30.0%	87.2%	98.1%	87.5%	92.2%
via Rest of World hubs	0.3%	0.0%	0.7%	1.1%	0.9%	12.8%	1.5%	12.2%	7.8%
Total non-UK hubs	12.3%	12.7%	5.6%	16.3%	30.9%	100.0%	99.6%	99.7%	100.0%

Source: MIDT, own elaboration.

3.4 Discussion

The results show an intense hub competition for passenger traffic moving to and from the UK and several factors can be mentioned in order to explain them. Market coverage, for example, seems to play an important role in helping foreign hubs to gain market share. For example, having a large feeder network from UK regions seems to help KLM in boosting connectivity from Amsterdam, and having a wide range of onward destinations appears to help British Airways in North America and the Middle East markets. The same applies to Emirates in the Asia-Pacific market. Obviously, these different network configurations do not depend exclusively on airlines' current strategies as they also depend on historical links and commercial relationships, as well as regulatory approaches to bilateral air service agreements and the application of the freedoms of the air. Furthermore, the ranking position of some airports in certain markets suggests that travellers are willing to withstand big detours even when a quicker travel option is available. This is the case, for example, for Dubai in the African market and for Amsterdam in the North American market. This conforms to the findings of previous studies that identify a trade-off between airfares and travel time in air passengers' choice of itineraries (see, for example, Hess, 2007).

In any case, these results appear to confirm the view of the UK Airports Commission and the UK Independent Transport Commission that a "decoupling" of UK regional markets has taken place. From a UK-centric perspective, this can be negatively interpreted as a sign that the worldwide connectivity of airports in UK regions is dependent on foreign airlines, airports, and governments. This can also be interpreted as market leakage for South East airports, which lose passengers travelling to onward destinations using foreign carriers and hubs.

On the other hand, it is worth noting that the increasing importance of foreign carriers offering services that bypass European hubs is consistent with the view that the future points towards the deconcentration of long-haul flight supply, which could potentially benefit non-hub airports. At the world level, Bowen (2002) and O'Connor (2003) detect a general tendency towards global deconcentration of seat capacity. For Europe, Bel and Fageda (2010), Maertens (2010) and Suau-Sanchez et al. (2014) observe a deconcentration of intercontinental flights due to hub-bypassing strategies of certain airlines. This type of strategy takes advantage of the economic growth of non-hub regions with the introduction of more efficient long-haul airliners and services that directly feed the foreign airline's hub avoiding congestion at European hubs. Indeed, the prominence of Istanbul Airport in recent years can be linked to the network strategies of Turkish Airlines along these lines.

Indeed, limited capacity at major European hubs is fostering the revival of multi-hub strategies (Burghouwt, 2014) as well as expelling airlines that are not willing to bear the costs of increased congestion (Derudder et al., 2007) or the price of a slot in the secondary trading market[12]. Yet, moving out of high density markets to supply new services in thinner markets requires not only of smaller aircraft (which decrease total trip costs, but increase costs per available seat-kilometre), but also of more efficient technology, which cut costs per available seat-kilometre. In this regard, the latest aircraft models (e.g., Boeing 787, Airbus 350) provide maximum range, designed to replace the B757, the 767, the first B777 generation, the A300s and the A310s, have a similar range as the jumbo B747, but with half the capacity (200-250 seats) and approximately 20% less fuel consumption advantage over the previous generation (e.g., B767/A330)[13]. Hence, with greater range, smaller cabin and better overall efficiency, these aircraft models appear to be designed to provide even more point-to-point long-haul traffic. In this vein, Mason (2007) considers that airlines choosing the B787 might eventually adopt a hub-bypassing strategy aimed at capturing high-yield passengers.

Besides aircraft technology, economic growth of non-hub regions may also help lifting demand. Since the year 2000, the European regional economy is increasingly being driven by second-tier urban regions, which outperform larger urban areas in terms of GDP per capita growth. Second-tier cities face fewer growth constraints and negative externalities (e.g., pollution, congestion costs, etc.) and, on occasions, enjoy better access to certain services than large core cities (OECD, 2009b, Dijkstra et al., 2012). As a result, O'Connor and Fuellhart (2013) observed changes in intercontinental seat capacity for the 2005-2010 period in favour of second-tier cities. In spite of that, the UK case is more complex since the growth gap between the 'North' and the 'South' has widened during the recent periods of economic growth (Gardiner et al., 2013). Hence, given the strong positive relationship between GDP per capita and the frequency of people living in a region to fly, one could argue that the "north" UK regions might have problems to leverage demand for long-haul air services. To counterbalance this situation, the UK government has suggested several strategies, such as the targeting of international tourism, establishing Local Enterprise Zones near airports, reforming of the Air Passenger Duty[14], considering other State aids and subsidies, improving the surface access to regional airports, and develop fifth-freedom traffic. Gulf carriers have been able to stimulate demand in some regional airports, even if passengers have to endure a longer travel, by offering lower ticket prices (Vespermann, et al., 2008; O'Connell, 2011). Indeed, several middle-size British cities, such as Glasgow, Edinburgh, Newcastle,

[12] See CAPA (2013) for a thorough analysis of slot trading at London-Heathrow.

[13] For example, Tembleque-Vilalta and Suau-Sanchez (2014) show for the Barcelona-Tokyo market that the economics of the Boeing 787 can turn an unfeasible route into a feasible one.

[14] The UK Government announced in early 2014 that the two higher bands of Air Passenger Duty would be abolished from April 2015.

Manchester and Birmingham are served by at least one of the three big Middle East carriers (i.e., Emirates, Etihad Airways and Qatar Airways). Therefore, one cannot ignore the effect of bypassing Heathrow on the creation of opportunities for regional airports to develop new international markets.

Finally, with regard to the market leakage argument, it is worth remembering that (due to data limitations) an unknown proportion of the long-haul travellers from South East airports are in fact starting their journey somewhere else, some of them in the regions. Therefore, the UK air transport network may benefit from the increased availability of long-haul air services at regional airports as it has potential to save space at Heathrow for other flights and helping reduce the pressure on the congested London airports.

4. CONCLUSIONS

This paper discusses the role of London Heathrow and the South East airports in providing worldwide connectivity for the UK. Results suggest that the strong hub competition in Europe, coupled with the lack of new route developments at Heathrow, may damage the latter's ranking among world-class connecting gateways in upcoming years. In absolute terms, more connecting UK passengers travel through Amsterdam or Dubai than through Heathrow. However, Heathrow Airport benefits from its massive traffic generation to remain the most central gateway for the overall UK air transport market.

When considering only the links between regional UK airports and the rest of the world, three quarters of the connecting traffic from these airports depends on non-UK hubs, particularly on flights to the Asia-Pacific or the BRIC countries where above 80% of passengers use these connections. Yet, Heathrow remains the main gateway of UK regions to North America and the Middle East, although it is facing substantial competition, especially from Amsterdam and Dubai, in the other long-haul markets. Disaggregated results for each of the UK Home Nations reveals differences in the connectivity profiles, with Northern Ireland showing lower levels of dependence on foreign hubs than other regions, Wales being fully dependent for long-haul markets, and Scotland showing poor direct connectivity to Asia-Pacific region. These differences highlight that there is not a "one size fits all" expression of aviation policy in this area and there is a necessity of taking into account regional views in the policy debate. In this regard, further exploration of the bilateral agreements between the UK and the BRIC countries also suggest that there is room for more liberalization in order to improve direct connectivity and stimulate demand from UK regional airports.

From a UK-centric perspective, on the one hand, our results can be interpreted as a sign of vulnerability for UK regions, whose worldwide connectivity is dependent on foreign airlines, airports, and governments. This can also be interpreted as market leakage for London airports, which lose passengers travelling to onward destinations to other foreign carriers and hubs. On the other hand, it cannot be ignored that the services offered from UK regional airports to other European hubs, such as Amsterdam, as well as the hub-bypassing services offered by US carriers and Middle Eastern carriers are indeed an opportunity for UK regional airports to develop new markets. In this regard, the combination of economic growth and more efficient new aircraft technology could be a game changer for some routes and cities. These results are in line with previous research on the deconcentration of long-haul services toward mid-tier airports. Furthermore, the UK air transport network may also benefit from the increased availability of long-haul air services at regional airports by saving space at Heathrow and helping reduce the pressure on the congested London airports.

Nevertheless, global developments show some limits to the benefits that regions can obtain from new hub-bypassing services. Not all regional airports are 'lucky' in getting this type of

services. Indeed, in the UK only a handful of regional airports are directly served by US and Middle Eastern carriers. Certainly, O'Connor and Fuellhard (2013) observed that changes in intercontinental seat capacity in second-ranked cities are very uneven. In this vein, Suau-Sanchez et al. (2014) highlight that, although hub-bypassing and new aircraft technology can connect more regions with direct long-haul services, there is evidence of increasing inequality in the availability of these services within the lower European airport tiers. Hence, we may expect an increasing level of polarisation in the range of connections available within the regional airports category.

Hence, overall, we can say that our findings support the general view on two main international developments. Firstly, hubs are still important to access long-haul markets, but increasing liberalisation and hub competition may bring the influence of the 'footloose connecting passenger' into consideration. Secondly, hub-bypassing will benefit a selected number of medium-size cities, but will, at the same time, increase the differences among regional airports.

Finally, it is worth noting that this analysis is mostly exploratory and it is limited by the available data. The results of this cross-sectional analysis suggest that a further longitudinal evaluation would bring interesting results. It is also worth mentioning the lack of information on the place of residence of UK passengers at South East airports, which could reveal a higher "true" contribution of the London hubs to UK regional connectivity, even if by means of a lengthy ground transfer. A more detailed and robust analysis of the actual determinants of hub traffic shares in long-haul routes from/to UK regional airports as well as the potential impact of other policy options, such as the introduction of new fifth-freedom services is also left for future research.

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Appendix A. Note on the Google Maps KMZ file

The Google Maps KMZ file represents the five most important hub choices of UK regional passengers in connecting itineraries to international destinations. In total, 70% of connecting traffic between the UK regions and the rest of the world is represented.

The width of the lines is proportional to the number of passengers in each flight sector. The scale is approximately 1:2,000 passengers. Only flight sectors carrying more than 20 passengers during the sample month are represented (width = 0.01).

The KMZ file, once opened in Google Earth, allows the user to select the hub networks to be represented in the map, allowing for less crowded visualization.